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M. FROIDEVAUX'S PARIS LETTER.

PARIS, Jan'y 31, 1902.

It would give a very incomplete idea of the activity displayed by the Geographical Service of the Army to speak only of the maps prepared and published by the officers; these maps are based upon rigorous geodetic performance. The geodetic section of the Science Géographique has accomplished, within a number of years past, under the impulse of Gen. Perrier and his successors, a truly remarkable scientific work.

The old French geodetic network, which serves as the basis of the map of France on a scale of 1:80,000, reposes entirely upon the meridian determined in 1790 by Delambre and Méchain as far as Barcelona, and prolonged by Biot and Arago to the Balearic Isles. Six parallel chains cross this meridian at a right angle and start from it; they are united to each other by three accessory meridians, which form, with the principal meridian and the parallels, the *gridiron* network, the meshes of which are occupied by a *filling-up* triangulation. Seven bases (Melun, Perpignan, Brest, Ensisheim, Bordeaux, Gourbeire, Aix) served for points of separation and of verification for this vast assemblage of triangles with which the geographical engineers at first, and afterwards (since 1831) the officers of the General Staff, covered the soil of France, following the methods of observation and of calculation designed by Delambre.

But while these methods were regarded in France as attaining the farthest limits of perfection, in other countries new methods were applied, thanks to which modern triangulations attained a much greater precision. This was recognised by Capt. Perrier in the course of the operations necessitated by the trigonometrical junction of France and England; and at the same time the Bureau des Longitudes, struck by the inferiority of the French triangulation compared with the new foreign triangulations, called for a revision of the Delambre-Méchain meridian. The determination of a new meridian was undertaken, in 1870, for the purpose of detecting and correcting the uncertainties and the errors which existed in the old network. This meridian, which reaches from the frontier of Spain (where it unites with the Spanish triangulation) to the Pas-de-Calais (where it joins the English and the Belgian network), reposes on a base of departure measured at Villejuif and two bases of verification at Perpignan and Cassel; it has been

verified by astronomical observations of longitude, latitude, and azimuth, as well at its extremities as from degree to degree. In addition, a new determination of the astronomical co-ordinates of the Pantheon was made by establishing in the open country, outside of Paris, far from the tremors and the atmospheric impurities of the capital, four stations, the co-ordinates of which were united with the Pantheon and the Observatory by a special triangulation. This new measurement of meridian was finished in 1896; and work is now proceeding on the re-measurement of those few portions of the chain in which the new meridian has brought errors to light.

At the same time, in preparation for the cadastral survey, the Geographical Service has begun the revision of the French triangulation, which suffices for the needs of the map on the scale of 1:80,000 and even for the work on the map of 1:50,000, but not for operations so precise as the execution of a cadastre.

The maps of Algeria and Tunisia, like that of France, are based upon a fundamental triangulation, forming a gridiron system which is completed by a polygonal triangulation of the first order, and furnishes a solid basis for the filling-up. The fundamental triangulation is composed of two great parallels of nearly 15 degrees (parallels of Algiers and Laghouat) and of four meridians (Méchéria, Laghouat, Biskra, Gabès).

The northern parallel (that of Algiers) extends from the frontier of Morocco, near Nemours, to the extremity of the Cape Bon peninsula in Tunisia, and is united on one side to Spain, on the other to Italy, by a special network of junction, devised and executed by Commandant Perrier. Between Sept. 9 and Oct. 16, 1879, were executed simultaneously on two summits of the Sierra Nevada (Mulhacen, 11,420 feet; and Tética, 6,828 feet), and two summits in Oran (Filhaoussen, 3,740 feet; and M'Sabiah, 1,916 feet), observations which effected the geodetic junction of Spain and Algeria. Similar operations in Italy and Tunisia completed the attachment of the parallel of Algiers to the European geodesy. The southern parallel (that of Laghouat) begins at the frontier of Morocco near Aïn Sefra, and ends on the Mediterranean near Gabès, passing through Géryville, Laghouat, Biskra, and Gafsa. It was in 1889-1895 that this second parallel was completed, corresponding in the main with the limit of the high plateaux, after the measurement of the meridian of France had been prolonged to the Sahara, with its northern extension already made to the Shetland Isles (through Laghouat), and the measurement of the three other meridians of Géryville, Biskra, and Gafsa. The two outer

meridians have been carried still further south; the two inner converge towards Ouargla—that of Laghouat by way of Gardāia, that of Biskra through Touggourt and the valley of the Oued Rhir (1899-1901). In this way has been established, by an uninterrupted chain of triangles, the greatest meridian arc which has yet been measured, extending from the Shetland Isles to the Desert of Sahara, through England, France, Spain, and Algeria, and across the English Channel and the Mediterranean. From an analogous point of view the Gafsa meridian is very interesting, since it may be considered (through the geodetic union of Sicily and Tunisia) as the prolongation of a great central meridian chain of Europe at an almost equal distance between those of France and Russia.

Eight bases have been established at the points of intersection of the meridians and parallels (Oran, Blidah, Bône, Tunis, Méchéria, Laghouat, Biskra, and Ksar Médenine), and fifteen stations form the astronomical network of verification—six on the northern parallel, six on the southern, and three on as many meridians.

Something must here be said of the measurement of the arc of the meridian at Quito by the party under Commandant Bourgeois. The arc to be measured extends through six degrees, from the south of Colombia to northern Peru; the network, comprising fifty-two stations, will rest upon three bases—one fundamental, in the centre, one in Colombia, and one in Peru. Complete astronomical observations will serve to determine the amplitude of the total arc, as well as to compare the geodetic co-ordinates with the astronomical, and study the form of our earth. Observations will also be made for the measurement of gravity, for the determination of magnetic elements and a geometrical level between the sea and the fundamental base.

There is but little of importance to note in geographical events. The Prince of Monaco has published a summary of his last year's voyage in the *Princesse Alice* along the West African coast to the Cape Verde and the Canary Islands. His scientific harvest was abundant, but the details are not yet accessible.

The recently-formed Oceanographical Society of the Bay of Biscay has accomplished 1,400 soundings in the estuary of the Gironde, and is at work upon the formation of a bathymetrical and lithological map of the estuary and of the submarine sector of the river deposits. Between the mouth of the Gironde and Cape Ortegal the Society has dropped 90 floats to furnish indications of the movement of currents, and has made soundings on the continental platform, off the French coast, with samples of the bottom.

In Africa, Capt. Salesses pushes the construction of the railway from Konakry to Kouroussa, on the Niger. Capt. Moll is at work on a map of the third military territory of the Sudan (scale of 1:2,000,000). Three Commissions have done their work: the Franco-Spanish on the limits of the Rio Muni territory; the Franco-German, on the frontier between the Kamerun and the French Congo; and the Franco-Portuguese, on the boundaries of Cabinda. At Dikoa, in the basin of the Chad, Commandant Destenave has found the remains of the unfortunate Béhagle, hanged by order of Rabah, after his long imprisonment.

In Asia, Mr. Gaston Bordat and M. Gervais-Courtellemont have made an interesting journey in Arabia, Persia, and Asia Minor, and Lieut. Hourst, completing the work of the Père Chevalier on the course of the Yang-tse-Kiang, has ascended the great river from I-Chang to Chungking in the gunboat *Obry*.

M. Largeau has undertaken reconnaissances in Espiritu Santo, in the New Hebrides, and M. Fauchère has gone to South America and the West Indies to study the plants (the coffee-tree, rubber plants, the cacao, tobacco, etc.), and select specimens for introduction into Madagascar.

A number of geographical works must be noticed. The first place belongs to the remarkable volume published by M. Kilian, under the patronage of the French Association for the Advancement of Science, entitled *Observations sur les variations des glaciers et l'enneigement dans les Alpes Dauphinoises*. These observations are due to the impulse given by a very active society of local Alpinists, and may be studied with Prince Roland Bonaparte's recent notes on the glaciers of the Alps and M. Joseph Vallot's work on the movement and the variations of the Mer de Glace.

The last number of the *Bulletin du Comité de l'Afrique Française* publishes the road-book of Commandant Laquière, which gives us the itineraries of the Servièrè column to Tidikelt, Tuat, and Gurara in 1900 and 1901, with important geographical information on that portion of the desert.

Some recent maps are of interest, such as M. de Flotte de Roqueraire's Hypsometrical Map of Morocco on a scale 1:3,000,000. This map has been made after 3,600 observations of altitudes, more than 1,900 of them unpublished. It brings together, and arranges in their proper relation, all the scattered indications on the relief of the surface of Morocco. Not less valuable is M. Coppolani's Map of the Saharan Mauritania, on a scale of 1:1,000,000. This region, lying between the Wady Draa, on the north, and Senegal

and the Sudan, on the south, has been under the protectorate of France since the end of December, 1899. Not to be overlooked are the two sheets of the interesting map published by Captain Lemaire, the complement, so to speak, of his previous works.

An admirably-illustrated volume on French Indo-China is the second volume of the series, entitled *L'Empire Colonial de la France*, though the text is not of a high order.

An excellent work of information on China and the Chinese is that of Elisée and Onésime Reclus, *L'Empire du Milieu*, an exact and well-ordered book.

Commandant A. de Gerlache brought out with the New Year the story of his voyage in the *Belgica*. It is an interesting volume, full of detail, and at the same time very well written and finely illustrated. By the side of this account, intended for the general public, the scientific reports by specialists in the various branches are issued by the Belgian Government in grand style. Two of these relate to oceanography: one by Thoulet, on the Determination of the Density of Sea-Water; the other by Thoulet and Arctowski, a Report on the Densities of Sea-Water, observed on board the *Belgica*.

A work by M. Vidal de La Blache, *La Rivière Vincent Pinzon*, is a study in the cartography of Guiana. The Swiss Federal Council, as arbitrator in the boundary question between France and Brazil, fixed upon the River Oyapok as the limit. M. de la Blache had previously seen reason to identify the river, known to the Spaniards of the sixteenth century as the Vincent Pinzon, with the Araguay, and he prints his argument as a contribution to science.

The best work yet published on the subject of the colonies is that by Marcel Dubois and Auguste Terrier, under the title, *Un Siècle d'Expansion Coloniale*.

I should reproach myself if I closed this letter without recording the grievous loss sustained by the Société de Géographie in the death of M. Charles Maunoir, its Honorary Secretary for thirty years, and its moving spirit. Much of the vigour and activity of the Society was due to his influence, and his annual Reports on the progress of geography form a remarkable history of the science for the period embraced. Every one who had been brought into relation with M. Maunoir had come to regard him, it is not too much to say, as a personal friend.

HENRI FROIDEVAUX.